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Host galaxies of luminous z~0.6 quasars

Major Mergers are not prevalent at the highest AGN luminosities

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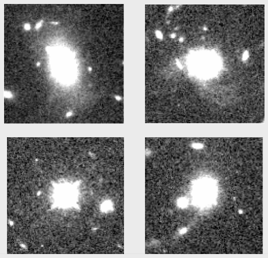
Why?

- ➡Active Galactic Nuclei (AGN) span close to 10 orders of magnitude in luminosity.
- ➡Accretion rate $\dot{M}$ scales with AGN luminosity, from << 1 $M_\odot$/ yr up to 10 $M_\odot$/ yr for the most luminous AGN.
- ➡Theoretical models predict that AGN triggering mechanisms depend on AGN luminosity due to differences in $\dot{M}$ (Hopkins & Hernquist 2009).
- ➡Mergers expected to dominate AGN triggering above $L_{bol} \gtrsim 10^{45}$ erg/s (Hopkins & Hernquist 2009, Somerville et al. 2008, Hopkins et al. 2008).

➽ are major mergers the dominant triggers of luminous quasars?

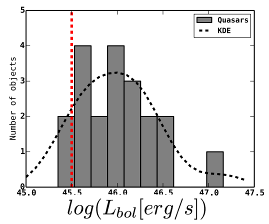
What?

- ➡HST H (rest-frame ~1μm) imaging of luminous X-ray selected AGN (0.5 < z < 0.7) with $L_{bol} \gtrsim 10^{45}$ erg/s
- ➡2D Image Decomposition (GALFIT)
- ➡Compare to a control sample matched in M_H luminosity (tracing stellar mass) from CANDELS
- ➡control galaxies are turned into mock AGN by adding point sources
- ➡quantitative morphological analysis and visual inspection



↑ 10" x 10" (~ 70 kpc x 70 kpc) cutouts 4 quasars

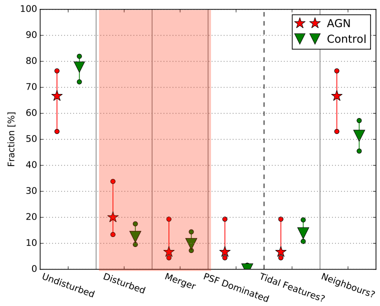
Sample & Data



← Distribution of AGN luminosities

- 20 X-ray selected SDSS Quasars
- 1 Orbit HST WFC3 F160W Imaging
- 15/20 have resolved host galaxies
- ~67% of hosts are disk-like, ~33% bulge-like

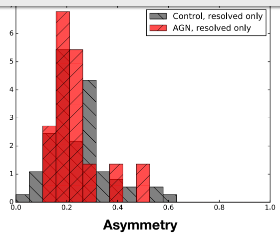
Results - Visual Classification



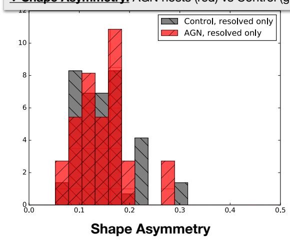
➡No difference between AGN hosts and control. No enhanced rate of major mergers in luminous quasars

Results - Quantitative Morphologies

↓ **Asymmetry:** AGN hosts (red) vs Control (grey)



↓ **Shape Asymmetry:** AGN hosts (red) vs Control (grey)



- ➡**Asymmetry**: integrate over residuals after 180° rotation. Measure is sensitive to early major mergers (see e.g. Lotz et al. 2010a,b)
- ➡**Shape Asymmetry** (Pawlik et al. 2016): as asymmetry, but using masks to enhance signal from faint extended features, sensitive to late mergers.

➡No difference between AGN hosts and control.

Summary

- ➡ **No sign of increased merger signatures in luminous quasars at z~0.6**
- ➡ taking into account observational limitation, we find an **upper limit of the enhanced major merger fraction < 15% from visual classification and <20% from quantitative analysis**

➽ mergers play only a minor role in AGN fueling at z~0.6

Conclusions - Major Mergers and AGN Fueling

There are no signs that major merging triggering dominates at high AGN luminosities

Samples with uniform selection over a wide range of luminosities (see also Villforth et al. 2014) show no increase with major merger incidence when compared to control samples.

Time delays between merger and onset of AGN activity needs to be long (~1 Gyr) to explain results

Comparison with simulations show that major mergers (≳1:4) up to ~1 Gyr after coalescence should be detectable. Time delays are unlikely to explain low merger incidence.

Lack of weak merger features speaks against an evolutionary scenario for a large fraction of unobscured AGN

Quasars in this study are unobscured both in the X-ray and optical, but sensitivity to old merger features speak against late evolutionary stage.

Morphology data suggest that AGN up to the highest luminosities are primarily fueled by minor mergers (<1:4) or secular processes. Delays and sample selection cannot account for lack of major mergers.

References: Hopkins & Hernquist 2009, ApJ, 694, 599; Hopkins et al. 2008, ApJS, 175, 356; Lotz et al. 2010, MNRAS, 404, 575 (a) / 590 (b); Pawlik et al. 2016, 456, 3032; Somerville et al. 2008, MNRAS, 391, 482; Villforth et al. 2014, MNRAS, 439, 3342; Villforth et al. 2017, 466, 812

CANDELS (http://candels.ucolick.org/): Grogin et al. 2011, ApJS, 197, 35; Koekemoer et al. 2011, ApJS, 197, 36